Advanced biomaterials and biofabrication techniques

Academic Year: (2024 / 2025) **Review date: 16-05-2024**

Department assigned to the subject: Bioengineering Department

Coordinating teacher: MARTINEZ SANTAMARIA, LUCIA

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.
CG7. Undertake further specialized studies, both in physics and in the various branches of engineering.
CE8. Understand and handle the basics of organic chemistry and its use in the production of complex materials and biological systems.
CE11. Analyze biological systems as complex systems, know the concepts of synthetic biology and apply the latest developments in biomaterials and biofabrication techniques, including bioprinting techniques.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.

RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study.
RA4. To be able to successfully manage themselves in the complex situations that might arise in their

academic or professional fields of study and that might require the development of novel approaches or solutions.
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Biomaterials: Principles, types and properties
2. Biomaterials biocompatibility: cell-material interaction
3. Biomaterials Implantation and interaction with the human body
4. Biomaterials for tissular engineering and regenerative medicine
5. micro
ano biomaterials design: microfabrication, modification and functionalization
6. Biomaterials design for 3D printing
7. Biosensors
8. Nanotechnology and system for controlled delivery of drugs, proteins and genes
9. Biomaterials for devices "lab-on-a-chip" and ¿tissue/organ/body-on-a-chip

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

% end-of-term-examination:	25
% of continuous assessment (assigments, laboratory, practicals…):	75

Grading will be based on continuous evaluation and a final exam covering the whole subject, including invited lectures and seminars. Help sessions and tutorial classes will be held prior to the final exam upon students´ request.
Attendance to lectures and seminars is not compulsory. However, failure to attend any test or submit the exercises before the deadline will result in a mark of 0 in the corresponding continuous evaluation block (see below).
Grading will be based on continuous evaluation and a final exam covering the whole subject, including invited lectures and seminars. Help sessions and tutorial classes will be held prior to the final exam upon students´ request.
The attendance to 80 % of practical sessions is mandatory.

GRADING:
Total score: 10 points
Continuous evaluation: 7.5 points out of 10
Final exam: 2.5 points out of 10

% end-of-term-examination:	25
% of continuous assessment (assigments, laboratory, practicals…):	75

CONTINUOUS EVALUATION: It accounts for up to 75% of the final score of the subject (7.5 points of the TOTAL SCORE), and includes two components:
1) Two tests: 5 points of THE TOTAL SCORE (2.5 points each). These tests will take place mostly during lectures and will be announced at least one week in advance. These tests will be not included in the final exam
2) Practical sessions in the laboratory. 2.5 points of THE TOTAL SCORE. The final exam will include some questions regarding the laboratory sessions.

FINAL EXAM: it will account for the 25 % of the final score (2.5 points of the TOTAL SCORE). The minimum score in the final exam to pass the subject is 4 over 10, notwithstanding the mark obtained in continuous evaluation

EXTRAORDINARY EXAM: there are two possibilities:
a) Examination of all the topics of the course (100% extraordinary exam mark)
b) Evaluation will follow the same criteria as the continuous evaluation (75% continuous evaluation, 25% final exam)

ACADEMIC CONDUCT: Unless specified, all exams will be closed-book, closed-notes, no PC or mobile phone, or anything else other than a writing implement and the exam itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infractions whatever will result in a failing grade.

BASIC BIBLIOGRAPHY

- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons. Biomaterials Science: An Introduction to Materials in Medicine., Academic Press, 2012

- Chee Kai Chua, Wai Yee Yeong Bioprinting:Principles and Applications (Wspc Book Series in 3D Printing), World Scientific Publishing, 2015

- Jason A. Burdick and Robert L. Mauck. Biomaterials for Tissue Engineering Applications: A Review of the Past and Future Trends., Springer Verlag., 2011

- Johnna S. Temenoff and Antonios G. Mikos. Biomaterials: The Intersection of Biology and Materials Science., Prentice Hall, 2009